

WHAT IS CLAIMED IS:

1. A thin film semiconductor apparatus comprising thin film transistors integrated on a substrate, and a wiring connecting said thin film transistors,

each of said thin film transistors comprising a channel which has a predetermined threshold voltage and on-off operates depending on a gate voltage applied through a wiring.

10 at least a part of said thin film transistors comprising a semiconductor thin film constituting said channel, and a first gate electrode and a second gate electrode, which are disposed on a surface and the other surface of said semiconductor thin film sandwiching an insulating film,

wherein said first gate electrode and said second gate electrode receive a first gate voltage and a second gate voltage, respectively, through wirings which are separately provided,

20 wherein said first gate electrode on-off controls said channel depending on said first gate voltage, and

wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage to adjust the on-off operation of said thin film transistors.

2. The semiconductor apparatus according to claim 1, wherein said semiconductor thin film constituting said channel is comprised of polycrystalline silicon which does not contain an impurity effectively affecting the formation of a depletion layer, and has a thickness of

Sub  
Apt

00000000000000000000000000000000

100 nm or less.

3. The semiconductor apparatus according to claim 1,  
wherein said semiconductor thin film constituting said  
channel is comprised of polycrystalline silicon which  
contains an impurity effectively affecting the formation  
of a depletion layer, and has a thickness two times or  
less the maximum of the thickness of said depletion layer.

10 4. The semiconductor apparatus according to claim 1,  
wherein said second gate electrode actively controls said  
threshold voltage depending on said second gate voltage  
applied at least when said thin film transistors off-  
operate, to thereby decrease a current flowing through  
15 said channel when said thin film transistors off-operate,  
as compared to a current flowing through said channel  
when said second gate voltage is not applied.

5. The semiconductor apparatus according to claim 1,  
20 wherein said second gate electrode actively controls said  
threshold voltage depending on said second gate voltage  
applied at least when said thin film transistors on-  
operate, to thereby increase a current flowing through  
said channel when said thin film transistors on-operate,  
25 as compared to a current flowing through said channel  
when said second gate voltage is not applied.

30 *B1* 6. A liquid crystal display comprising a pair of  
substrates disposed having a predetermined gap, and a  
liquid crystal kept in said gap,  
one of said substrates containing thereon a display

portion in which a pixel electrode and a thin film transistor for driving said pixel electrode are integrated, and a peripheral circuit portion in which thin film transistors are integrated,

- 5       the other of said substrates containing thereon an opposite electrode which faces said pixel electrode,

B1  
each of said thin film transistors comprising a channel which has a predetermined threshold voltage and on-off operates depending on a gate voltage applied  
10      through a wiring, at least a part of said thin film transistors comprising a semiconductor thin film constituting said channel and a first gate electrode and a second gate electrode, which are disposed on a surface and the other surface of said semiconductor thin film  
15      sandwiching an insulating film,

wherein said first gate electrode and said second gate electrode receive a first gate voltage and a second gate voltage, respectively, through wirings which are separately provided,

20      wherein said first gate electrode on-off controls said channel depending on said first gate voltage, and wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage to adjust the on-off operation of said thin film  
25      transistors.

7.      The liquid crystal display according to claim 6, wherein said semiconductor thin film constituting said channel is comprised of polycrystalline silicon which  
30      does not contain an impurity effectively affecting the formation of a depletion layer, and has a thickness of

100 nm or less.

8. The liquid crystal display according to claim 7,  
wherein, in all of the thin film transistors contained in  
5 said display portion and said circuit portion, said  
semiconductor thin film constituting said channel does

*Bl*  
not contain an impurity effectively affecting the  
formation of a depletion layer.

10 9. The liquid crystal display according to claim 6,  
wherein said semiconductor thin film constituting said  
channel is comprised of polycrystalline silicon which  
contains an impurity effectively affecting the formation  
of a depletion layer, and has a thickness two times or  
15 less the maximum of the thickness of said depletion layer.

10. The liquid crystal display according to claim 9,  
wherein, in all of the thin film transistors contained in  
said display portion and said circuit portion, said  
20 semiconductor thin film constituting said channel  
contains impurity of the same conductive type effectively  
affecting the formation of a depletion layer.

11. The liquid crystal display according to claim 6,  
25 wherein said second gate electrode actively controls said  
threshold voltage depending on said second gate voltage  
applied at least when said thin film transistors off-  
operate to thereby decrease a current flowing through  
said channel when said thin film transistors off-operate,  
30 as compared to a current flowing through said channel  
when said second gate voltage is not applied.

12. The liquid crystal display according to claim 6,  
wherein said second gate electrode actively controls said  
threshold voltage depending on said second gate voltage  
5 applied at least when said thin film transistors on-  
operate, to thereby increase a current flowing through  
said channel when said thin film transistors on-operate,  
as compared to a current flowing through said channel  
when said second gate voltage is not applied.

10

13. An electroluminescence display comprising a  
substrate having thereon a display portion in which an  
electroluminescence device and a thin film transistor for  
driving said electroluminescence device are integrated,  
15 and a peripheral circuit portion in which thin film  
transistors are integrated,

each of said thin film transistors comprising a  
channel which has a predetermined threshold voltage and  
on-off operates depending on a gate voltage applied  
20 through a wiring, at least a part of said thin film  
transistors comprising a semiconductor thin film  
constituting said channel, and a first gate electrode and  
a second gate electrode, which are disposed on a surface  
and a back surface of said semiconductor thin film  
25 through an insulating film,

wherein said first gate electrode and said second  
gate electrode receive a first gate voltage and a second  
gate voltage, respectively, through wirings which are  
separately provided,

30 wherein said first gate electrode on-off controls  
said channel depending on said first gate voltage, and

TOKYO 6-12-29 1994

wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage to adjust the on-off operation of said thin film transistors.

5

14. The electroluminescence display according to claim  
B1 13, wherein said semiconductor thin film constituting  
said channel is comprised of polycrystalline silicon  
which does not contain an impurity effectively affecting  
10 the formation of a depletion layer, and has a thickness  
of 100 nm or less.

15. The electroluminescence display according to claim  
14, wherein, in all of the thin film transistors  
15 contained in said display portion and said circuit  
portion, said semiconductor thin film constituting said  
channel does not contain an impurity effectively  
affecting the formation of a depletion layer.

20 16. The electroluminescence display according to claim  
13, wherein said semiconductor thin film constituting  
said channel is comprised of polycrystalline silicon  
which contains an impurity effectively affecting the  
formation of a depletion layer, and has a thickness two  
25 times or less the maximum of the thickness of said  
depletion layer.

17. The electroluminescence display according to claim  
16, wherein, in all of the thin film transistors  
30 contained in said display portion and said circuit  
portion, said semiconductor thin film constituting said

202523250

channel contains impurity of the same conductive type effectively affecting the formation of a depletion layer.

18. The electroluminescence display according to claim  
5 13, wherein said second gate electrode actively controls  
said threshold voltage depending on said second gate  
B1 voltage applied at least when said thin film transistors  
off-operate, to thereby decrease a current flowing  
through said channel when said thin film transistors off-  
10 operate, as compared to a current flowing through said  
channel when said second gate voltage is not applied.

19. The electroluminescence display according to claim  
13, wherein said second gate electrode actively controls  
15 said threshold voltage depending on said second gate  
voltage applied at least when said thin film transistors  
on-operate, to thereby increase a current flowing through  
said channel when said thin film transistors on-operate,  
as compared to a current flowing through said channel  
20 when said second gate voltage is not applied.

20. A method for driving a thin film semiconductor  
apparatus which comprises thin film transistors  
integrated on a substrate, and a wiring connecting said  
25 thin film transistors, each of said thin film transistors  
comprising a channel which has a predetermined threshold  
voltage and on-off operates depending on a gate voltage  
applied through a wiring, at least a part of said thin  
film transistors comprising a semiconductor thin film  
30 constituting said channel, and a first gate electrode and  
a second gate electrode, which are disposed on a surface

and the other surface of said semiconductor thin film sandwiching an insulating film,

wherein said first gate electrode and said second gate electrode receive a first gate voltage and a second 5 gate voltage, respectively, through wirings which are separately provided,

*B1* wherein said first gate electrode on-off controls said channel depending on said first gate voltage, and wherein said second gate electrode actively controls said 10 threshold voltage depending on said second gate voltage to adjust the on-off operation of said thin film transistors.

21. The method according to claim 20, wherein said 15 semiconductor thin film constituting said channel is comprised of polycrystalline silicon which does not contain an impurity effectively affecting the formation of a depletion layer, and has a thickness of 100 nm or less.

20  
22. The method according to claim 20, wherein said semiconductor thin film constituting said channel is comprised of polycrystalline silicon which contains an impurity effectively affecting the formation of a 25 depletion layer, and has a thickness two times or less the maximum of the thickness of said depletion layer.

23. The method according to claim 20, wherein said second gate electrode actively controls said threshold 30 voltage depending on said second gate voltage applied at least when said thin film transistors off-operate, to

thereby decrease a current flowing through said channel when said thin film transistors off-operate, as compared to a current flowing through said channel when said second gate voltage is not applied.

5

24. The method according to claim 20, wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage applied at least when said thin film transistors on-operate, to

10 thereby increase a current flowing through said channel when said thin film transistors on-operate, as compared to a current flowing through said channel when said second gate voltage is not applied.

15 25. A method for driving a liquid crystal display which comprises a pair of substrates disposed together having a predetermined gap, and a liquid crystal kept in said gap,

one of said substrates containing thereon a display portion in which a pixel electrode and a thin film

20 transistor for driving said pixel electrode are integrated, and a peripheral circuit portion in which thin film transistors are integrated,

the other of said substrates containing thereon an opposite electrode which faces said pixel electrode,

25 each of said thin film transistors comprising a channel which has a predetermined threshold voltage and on-off operates depending on a gate voltage applied through a wiring, at least a part of said thin film transistors comprising a semiconductor thin film

30 constituting said channel, and a first gate electrode and a second gate electrode, which are disposed on a surface

and the other surface of said semiconductor thin film through an insulating film,

wherein said first gate electrode and said second gate electrode receive a first gate voltage and a second 5 gate voltage, respectively, through wirings which are separately provided,

*B1* wherein said first gate electrode on-off controls said channel depending on said first gate voltage, and wherein said second gate electrode actively controls said 10 threshold voltage depending on said second gate voltage to adjust the on-off operation of said thin film transistors.

26. The method according to claim 25, wherein said 15 semiconductor thin film constituting said channel is comprised of polycrystalline silicon which does not contain an impurity effectively affecting the formation of a depletion layer, and has a thickness of 100 nm or less.

20  
27. The method according to claim 26, wherein, in all of the thin film transistors contained in said display portion and said circuit portion, said semiconductor thin film constituting said channel does not contain an 25 impurity effectively affecting the formation of a depletion layer.

28. The method according to claim 25, wherein said 30 semiconductor thin film constituting said channel is comprised of polycrystalline silicon which contains an impurity effectively affecting the formation of a

depletion layer, and has a thickness two times or less than the maximum of the thickness of said depletion layer.

29. The method according to claim 28, wherein, in all of  
5 the thin film transistors contained in said display portion and said circuit portion, said semiconductor thin film constituting said channel contains impurity of the same conductive type effectively affecting the formation of a depletion layer.

10

30. The method according to claim 25, wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage applied at least when said thin film transistors off-operate, to thereby decrease a current flowing through said channel when said thin film transistors off-operate, as compared to a current flowing through said channel when said second gate voltage is not applied.

15 20 31. The method according to claim 25, wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage applied at least when said thin film transistors on-operate, to thereby increase a current flowing through said channel when said thin film transistors on-operate, as compared to a current flowing through said channel when said second gate voltage is not applied.

25 30 32. A method for driving an electroluminescence display which comprises a substrate having thereon a display portion in which an electroluminescence device and a thin

film transistor for driving said electroluminescence device are integrated, and a peripheral circuit portion in which thin film transistors are integrated,

each of said thin film transistors comprising a  
5 channel which has a predetermined threshold voltage and on-off operates depending on a gate voltage applied through a wiring, at least a part of said thin film transistors comprising a semiconductor thin film constituting said channel, and a first gate electrode and  
10 a second gate electrode, which are disposed on a surface and the other surface of said semiconductor thin film having an insulating film in between,

wherein said first gate electrode and said second gate electrode receive a first gate voltage and a second  
15 gate voltage, respectively, through wirings which are separately provided,

wherein said first gate electrode on-off controls said channel depending on said first gate voltage, and wherein said second gate electrode actively controls said  
20 threshold voltage depending on said second gate voltage to adjust the on-off operation of said thin film transistors.

33. The method according to claim 32, wherein said  
25 semiconductor thin film constituting said channel is comprised of polycrystalline silicon which does not contain an impurity effectively affecting the formation of a depletion layer, and has a thickness of 100 nm or less.

30  
34. The method according to claim 33, wherein, in all of

the thin film transistors contained in said display portion and said circuit portion, said semiconductor thin film constituting said channel does not contain an impurity effectively affecting the formation of a  
5 depletion layer.

B1 35. The method according to claim 32, wherein said semiconductor thin film constituting said channel is comprised of polycrystalline silicon which contains an  
10 impurity effectively affecting the formation of a depletion layer, and has a thickness two times or less the maximum of the thickness of said depletion layer.

36. The method according to claim 35, wherein, in all of  
15 the thin film transistors contained in said display portion and said circuit portion, said semiconductor thin film constituting said channel contains impurity of the same conductive type effectively affecting the formation of a depletion layer.

20 37. The method according to claim 32, wherein said second gate electrode actively controls said threshold voltage depending on said second gate voltage applied at least when said thin film transistors off-operate, to  
25 thereby decrease a current flowing through said channel when said thin film transistors off-operate, as compared to a current flowing through said channel when said second gate voltage is not applied.

30 38. The method according to claim 32, wherein said second gate electrode actively controls said threshold

voltage depending on said second gate voltage applied at  
least when said thin film transistors on-operate, to  
thereby increase a current flowing through said channel  
when said thin film transistors on-operate, as compared  
5 to a current flowing through said channel when said  
second gate voltage is not applied.